INFORMATION CIRCULAR 41

Pennsylvania Geological Survey
Fourth Series

GEOLOGIC INTERPRETATION of certain AEROMAGNETIC MAPS of LANCASTER, BERKS, & LEBANON COUNTIES

by

Arthur A. Socolow

COMMONWEALTH OF PENNSYLVANIA
DEPARTMENT OF INTERNAL AFFAIRS
Genevieve Blatt, *Secretary*
TOPOGRAPHIC AND GEOLOGIC SURVEY
Carlyle Gray, *State Geologist*

1961

AUG 15 1961

FOREWORD

Southeastern Pennsylvania is an area of extremely varied and complex geology with a long history of mineral production. The list of mineral commodities which this area has yielded at various times is considerable, but iron-ore stands out as the most prominent. Scores of iron mines and furnaces have operated in this area in the past 200 years. With a record of production dating back to Pre-Revolutionary War years, the mine at Cornwall is the oldest continuously operating iron mine in the United States. The recent development of the large and magnificent Grace Mine at Morgantown is living testimony to the fact that Pennsylvania's metallic mining record is not simply a story of the past. Through modern methods of exploration and research, new mineral resources remain to be found.

The Bureau of Topographic and Geologic Survey of the Department of Internal Affairs is pleased to have participated and cooperated with the United States Geological Survey in carrying out an aeromagnetic survey of Southeastern Pennsylvania. This modern exploration technique is particularly well suited to the geologic conditions and to the potential mineral resources of the area; it is an extremely efficient method of acquiring geologic data for a large region. The results of the aeromagnetic survey are being published by the United States Geological Survey as a series of aeromagnetic contour maps.

We are pleased to present this publication as a service to the Commonwealth of Pennsylvania. It is hoped that this interpretation and discussion of the aeromagnetic maps will serve as a stimulus for further research and development.

Genevieve Blatt

Genevieve Blatt, Secretary
Department of Internal Affairs

GEOLOGIC INTERPRETATION OF AEROMAGNETIC MAPS WOMELSDORF, SINKING SPRING, EPHRATA, TERRE HILL, LEOLA, NEW HOLLAND, GAP, LEBANON, RICHLAND, MANHEIM, LITITZ, COLUMBIA EAST, AND LANCASTER QUADRANGLES

General Statement

The magnetic contour maps discussed in this series of publications are the result of a cooperative project of the United States geological survey and the Pennsylvania Geological Survey, Department of Internal Affairs. About 5,000 square miles of southeastern Pennsylvania have been covered in this survey, the results of which are being published as individual 7 1/2-minute quadrangle maps.

This information circular is one of a series which are intended as a preliminary explanation of the interrelation of distinctive magnetic features with geological conditions in each quadrangle. In many instances unusual magnetic patterns can be explained by geological features which have been mapped and studied in the past. It is hoped that the map viewer will not only be aided by such correlation of data, but also that this publication may stimulate exploration and research in those areas where there is at present no known or satisfactory geological explanation for some of the magnetic features which appear on the magnetic contour map. Such exploration and research could directly or indirectly lead to discovery and development of new mineral deposits and would greatly advance the basic knowledge of the geology of Pennsylvania.

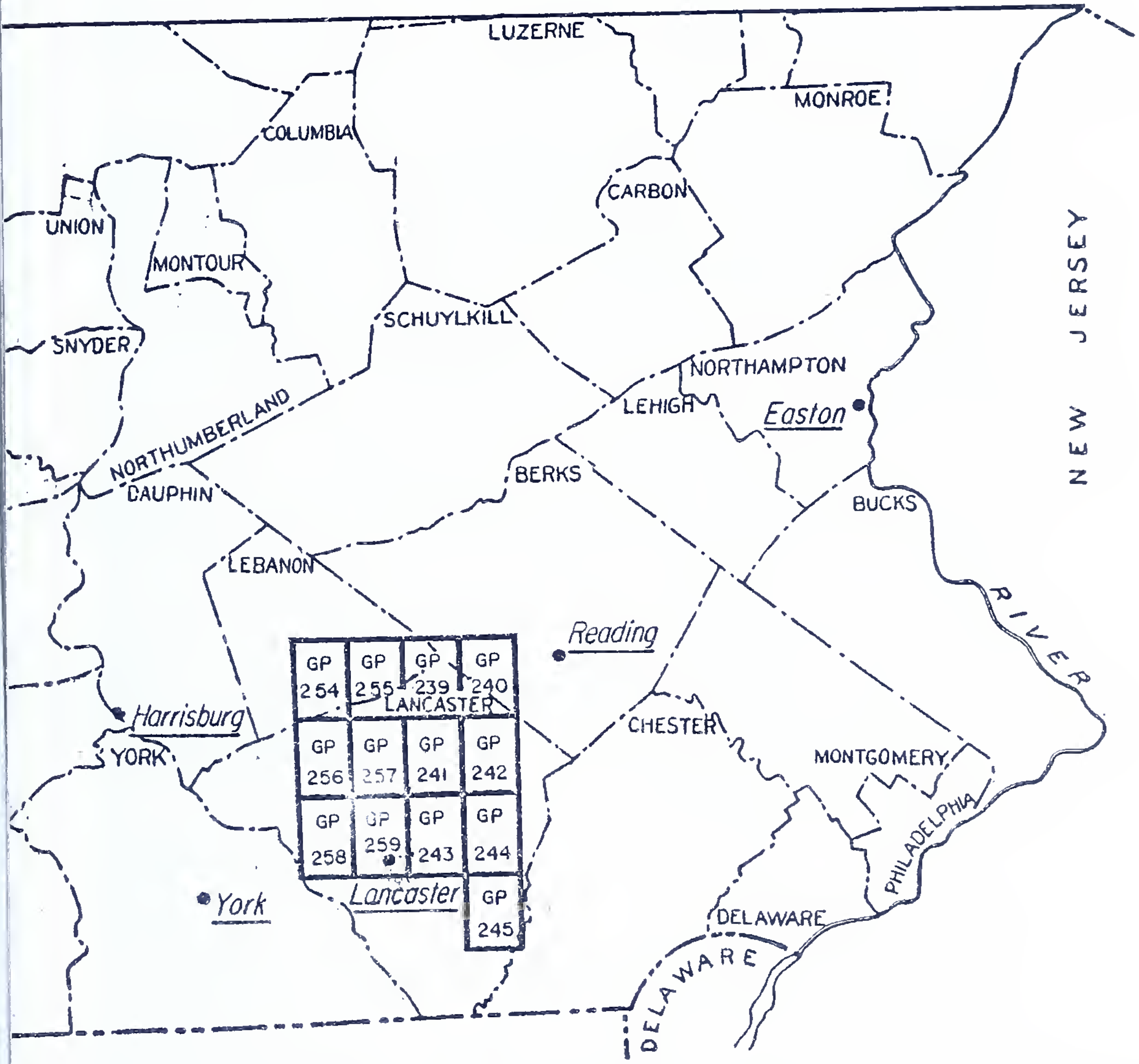
The magnetic contour lines on the map are lines connecting points of equal magnetic intensity. The shape, position, and spacing of the magnetic lines are the result of the combined effects of the earth itself, which is a huge magnet, and of local variations in the magnetism of the rocks underlying any given area. If the earth as a large, uniform body were the only factor responsible for the magnetic lines, they would be essentially straight and uniform. It is the local geology, however, which imparts complexities to the patterns of the magetic lines. Such complexities or variations from a simple pattern are called anomalies.

Local magnetic effects vary from place to place because the magnetic properties of the respective rocks are not alike. Rocks which have different kinds or different relative amounts of minerals, particularly iron-bearing minerals, have unlike magnetic properties. In general, the more iron minerals present, the stronger the magnetic effect. The iron oxide mineral, magnetite, has a strong magnetic effect even when present in small quantities; when present in large amounts, magnetite is of economic interest as a possible iron ore.

Rock structures may have brought together rocks of contrasting character. Thus, in a given area, if the rocks have been folded or faulted by internal earth forces, the resulting variation in position of the different rocks will be indicated by variation in magnetic readings from place to place. Thus, structural complexities as well as mineral variations may be revealed by the magnetic data. Of particular interest are those magnetic variations or anomalies which are circular or tend to enclose a given area; the implication in such cases is that there is a specific, localized causative factor more or less pin-pointed by such a pattern.

The aeromagnetic survey of southeastern Pennsylvania was carried out with an airborne magnetometer, an instrument towed by a plane. The plane covered the area by flying back and forth along straight, parallel flight lines spaced a quarter mile apart. An attempt was made to maintain an elevation of 500 feet above the ground in order to eliminate magnetic changes resulting from variations in the terrain. An airborne magnetic survey has the advantage of eliminating very minor magnetic features on the ground, thus permitting a better evaluation of larger and deeper magnetic phenomena. It should be borne in mind that the instruments which have measured the magnetic effects in these studies are very sensitive and capable of detecting small changes. Proper evaluation of these changes is necessary to distinguish those situations which offer possibilities for economic mineral development from those cases where the information yielded is of more academic interest.

INDEX OF AEROMAGNETIC MAPS DISCUSSED IN THIS PUBLICATION



GP 239 Womelsdorf quadrangle
GP 240 Sinking Spring quadrangle
GP 241 Ephrata quadrangle
GP 242 Terre Hill quadrangle
GP 243 Leola quadrangle
GP 244 New Holland quadrangle
GP 245 Gap quadrangle
GP 254 Lebanon quadrangle
GP 255 Richland quadrangle
GP 256 Manheim quadrangle
GP 257 Lititz quadrangle
GP 258 Columbia East quadrangle
GP 259 Lancaster quadrangle

FIGURE I.

Womelsdorf Quadrangle
U. S. Geological Survey Aeromagnetic Map G. P. 239

The Womelsdorf quadrangle aeromagnetic map is dominated by a broad magnetic high which is centered near the junction of Lebanon, Lancaster, and Berks Counties. This is the center of a topographic high known as South Mountain, a more or less oval area made up of Precambrian granitic gneiss with lesser amounts of hornblende gneiss. Such rock units are typically characterized by sharp magnetic highs. These crystallines are overlapped on the north and northwest by Hardyston quartzite and successively younger limestones of Cambrian age. To the south, the South Mountain crystallines are in fault contact with Triassic sediments. The sedimentary units in the quadrangle have little magnetic variation and low intensity.

The magnetic high over the South Mountain crystallines has an amplitude of only 200 gammas. This is unusually small for a crystalline mass which is in such marked petrographic and topographic contrast to the adjacent sediments. Such a small anomaly is interpreted to signify that the crystalline mass is relatively thin, being part of a rootless thrust sheet. This interpretation has been incorporated in the 1960 edition of the Geologic Map of Pennsylvania. No mineralization of economic significance is magnetically indicated in the Womelsdorf quadrangle.

Sinking Spring Quadrangle
U. S. Geological Survey Aeromagnetic Map G. P. 240

Although the magnetic pattern on the Sinking Spring map shows considerable variation, a direct correlation can be established between the known lithologies and the magnetic features.

The northern half of the quadrangle has only a few, widely spaced magnetic contours. This is an area of Ordovician limestones and shales of uniform, low magnetic intensity.

A magnetic high occurs in the southeastern part of the quadrangle in Spring Township, about a mile northwest of Gouglersville. The anomaly has an amplitude of about 400 gammas. It is located over a Triassic diabase dike; the ferromagnesian minerals plus the accessory magnetite in the diabase appear to be responsible for this anomaly. No economically significant iron mineralization is indicated, however.

There are two magnetic highs of low amplitude in the west-central part of the quadrangle. One is centered over Cushion Peak west of Fritztown; the other is located west of Highland in South Heidelberg Township. The Cushion Peak area is one where a veneer of Hardyston quartzite lies on Precambrian granitic gneiss. The South Heidelberg anomaly is directly underlain by gneiss. The iron-bearing minerals of the gneiss tend to produce magnetic highs in contrast to the adjacent sedimentary rocks. The small area and amplitude of the anomalies, and the mineral composition of the gneiss, indicate there is no iron concentration of economic interest at these locations.

Ephrata Quadrangle
U. S. Geological Survey Aeromagnetic Map G. P. 241

The Ephrata quadrangle aeromagnetic map denotes an area of very minor magnetic variation. This is an area consisting of Cambro-Ordovician shales and limestones and a downfaulted wedge of Triassic shales and sandstones. There is considerable faulting in the area, as well as some folding, but the considerable thicknesses and relatively uniform magnetic intensities of these units do not permit them to reflect the structures on the magnetic map. There are no distinctive anomalies and no magnetic mineralization is indicated.

Terre Hill Quadrangle
U. S. Geological Survey Aeromagnetic Map G. P. 242

The Terre Hill quadrangle aeromagnetic map shows a sizable positive magnetic anomaly in Brecknock Township in the northeast portion of the quadrangle. The anomaly, with a relief of over 500 gammas, is developed directly over a mass of intrusive Triassic diabase. The shape of the anomaly corresponds to the outcrop area of the diabase. The anomaly is apparently a result of the ferruginous minerals and accessory magnetite in the diabase, accentuated by the considerable thickness of the igneous intrusive. There has also been a small amount of contact metamorphism effected in the ferruginous Triassic sediments. However, no economically significant mineralization is indicated in either the diabase or the sediments.

The other sections of the quadrangle exhibit very little magnetic relief, being underlain by considerable thicknesses of Cambro-Ordovician limestones, dolomites, and shales, as well as Triassic sandstones and shales. The magnetic map does not indicate any outstanding structural or mineralogical variations within these units.

Leola Quadrangle
U. S. Geological Survey Aeromagnetic Map G. P. 243

The Leola quadrangle map has a very simple pattern with widely spaced magnetic contour lines. This is an area of Cambrian and Ordovician limestones and dolomites which have been considerably folded and faulted. These sediments are thick here and of relatively uniform magnetic intensity, so that the structure is not indicated by the magnetic pattern. No magnetic anomalies are present on the map and no magnetic mineralization is indicated.

New Holland Quadrangle
U. S. Geological Survey Aeromagnetic Map G. P. 244

The New Holland quadrangle aeromagnetic map is dominated by a positive magnetic anomaly in East Earl Township in the east central section of the quadrangle. The anomaly has an amplitude of nearly 300 gammas, is oval in shape, and has a diameter of nearly two miles. This magnetic feature is located over a ridge of Chickies quartzite. However, it appears from the magnetic pattern that the anomaly source is fairly deep seated, probably the subsurface extension of a mass of gabbroic gneiss which is exposed a few miles to the east where it is the apparent source of two small magnetic highs. The gabbroic gneiss, much of which may be metasedimentary, is exposed in the New Holland quadrangle just southwest of Mount Airy, where it forms a small, secondary magnetic high at the edge of the larger one described above. No economic concentration of magnetic material is indicated in this area, nor elsewhere in the New Holland quadrangle. The rest of the quadrangle has only a small magnetic variation, being underlain by a folded and faulted sequence of Cambrian limestones, dolomites, quartzite, schist, and phyllite. They apparently have fairly uniform magnetic intensities, inasmuch as the magnetic map pattern does not reflect the structures present.

Gap Quadrangle
U. S. Geological Survey Aeromagnetic Map G. P. 245

The Gap quadrangle aeromagnetic map shows a diversity of patterns which can be correlated with the variety of lithologies which have been mapped in the area.

The northern edge of the quadrangle has very few, widely spaced magnetic lines. This is an area of Cambro-Ordovician limestones, dolomites, phyllite, and quartzite which have uniform, low magnetic intensities.

The southern third of the quadrangle shows a pattern of closely spaced, northeasterly trending magnetic lines. This section is underlain by albite-chlorite-bearing Wissahickon schist, as well as by a synclinal belt of Peters Creek sericite-quartz schist in the southeast corner of the quadrangle. The Peters Creek area forms a magnetic low compared with the pattern over the belt of Wissahickon schist. The Wissahickon schist contains minor amounts of iron silicate minerals, as well as very small quantities of magnetite. Such positive magnetic anomalies as occur in Bart Township, a mile north of Bartville, and in Bart Township, two miles northeast of Bartville, signify only very minor concentrations of iron-bearing minerals which have no economic significance.

In the central portion of the quadrangle there is a northeasterly trending belt exhibiting relatively little magnetic variation, yet showing several separate magnetic highs. This is a belt of complex lithology. A mass of granitic Baltimore gneiss, forming the core of the Mine Ridge anticlinorium, is overlapped on the flanks by a belt of Chickies quartzite. Within the gneiss there are intrusives of quartz monzonite, serpentinite, and metagabbro.

In Bart Township the margin of the metagabbro, or norite, was mined for its nickel content from 1862 to 1893, at which time competition with higher grade foreign ores put it out of business. The ore mineral in the norite is pentlandite (a sulfide of iron and nickel) and the general geologic setting is very similar to that of the Sudbury (Canada) nickel deposit. The Gap nickel ore ranged from 1 to 3 per cent nickel content (Knopf and Jones, 1929) and was smelted right at the site. The aeromagnetic map shows a small magnetic anomaly at the site of the old nickel mine, with a rather meager amplitude of about 50 gammas.

In Paradise Township about a half mile north of the Gap nickel mine site, the magnetic map shows a distinct positive anomaly. It has an east-west trend, is about a half mile long, and has an amplitude of nearly 200 gammas. This is a challenging feature, for it is developed over gently dipping Chickies Quartzite whose mineralogy offers no logical anomaly source. The Chickies here is not very thick and it is directly underlain by the crystalline core of the Mine Ridge anticlinorium. It would seem likely that the anomaly is related to one of the relatively iron-rich lithologies which have intruded the granitic gneiss, such as serpentinite or metagabbro. The proximity of Gap nickel-bearing metagabbro makes the anomaly all the more intriguing, particularly since the pyrrhotite-pentlandite mineralogy is slightly magnetic. It must be cautioned, however, that a body of metagabbro could be non-ore-bearing and still have enough ferruginous minerals to account for the anomaly. Similarly, in other parts of southeast Pennsylvania it has been found that intrusive serpentinites have small quantities of disseminated magnetite which are responsible for magnetic highs, though of no commercial significance; this is therefore another possible explanation for the source of this magnetic anomaly.

A small magnetic high is located a mile southwest of Coopersville in Sadsbury Township. This feature is developed over a narrow belt of steeply dipping Chickies, Antietam, and Harpers Formations. The latter two have been found to contain small amounts of disseminated magnetite grains in other parts of Lancaster County. A similar magnetic source is indicated here, although neither the size nor the amplitude of the anomaly indicates a significant or commercial concentrate of iron mineralization.

Lebanon and Richland Quadrangles
U. S. Geological Survey Aeromagnetic Maps G.P. 254 and G. P. 255

The Lebanon and Richland aeromagnetic maps are of particular interest inasmuch as they include Cornwall,

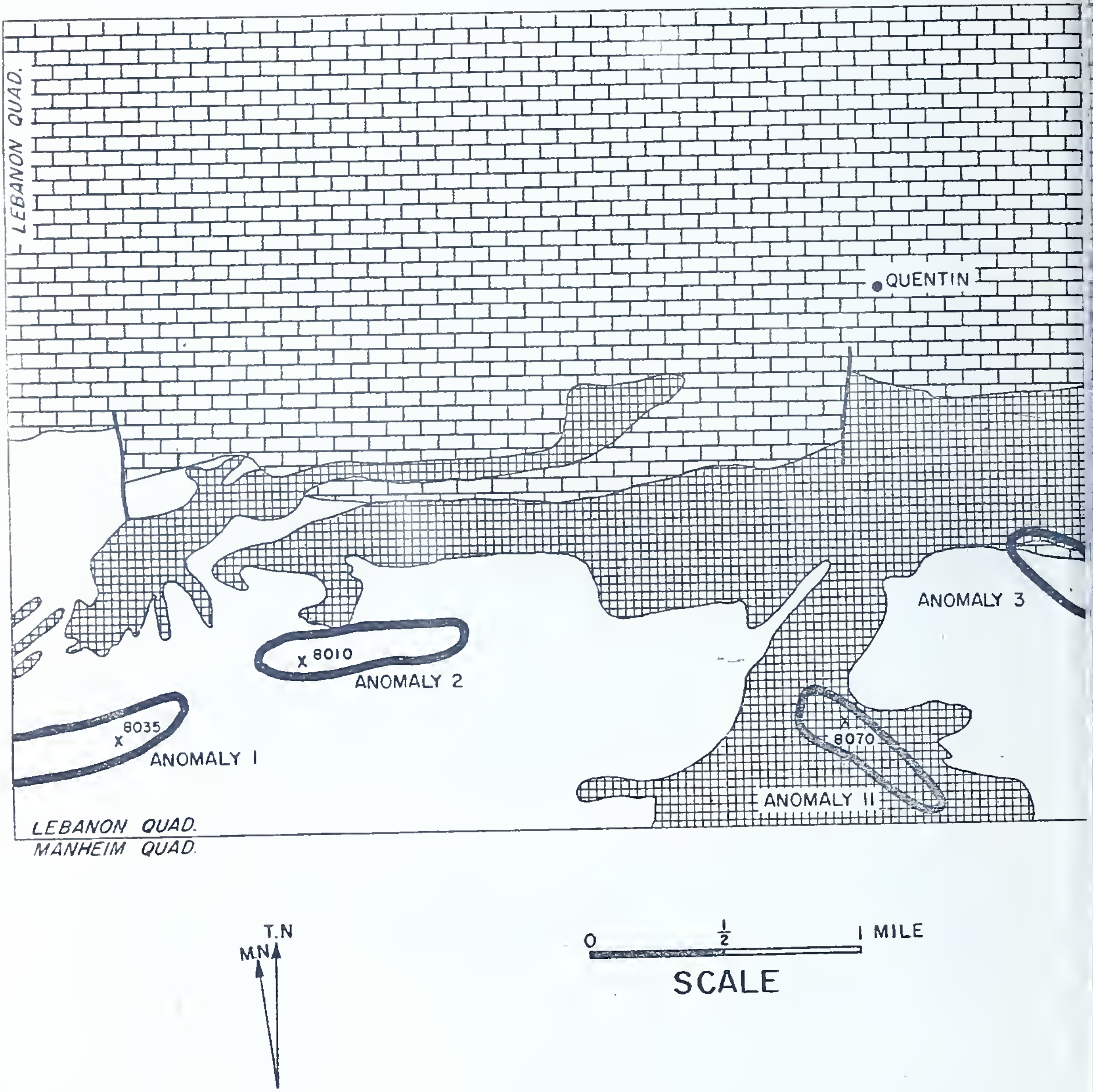
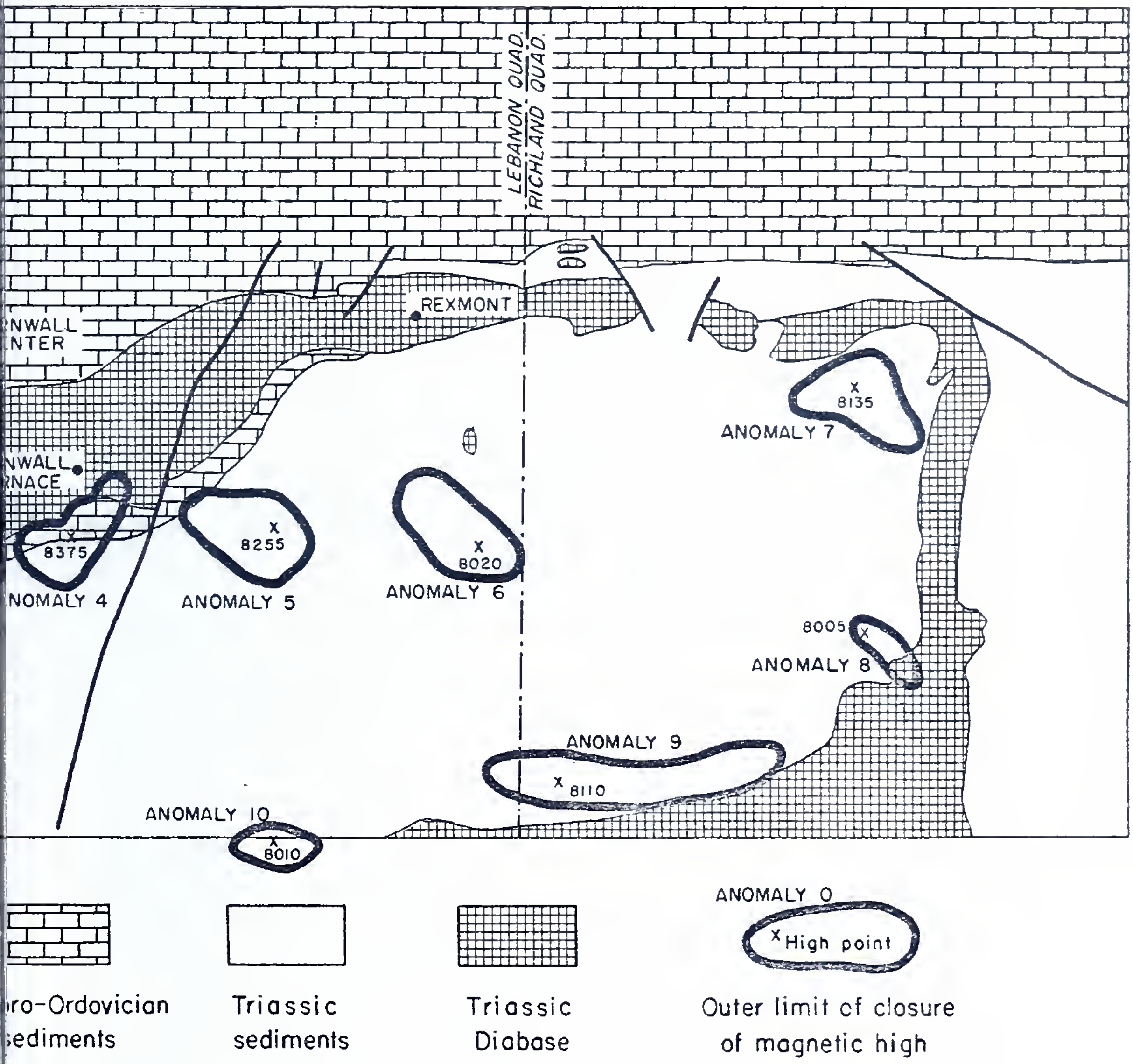


Figure 2. Positive Magnetic Anomalies an



of the Cornwall Area, Pennsylvania.

one of the two, large, iron-mining operations in Pennsylvania (Gray and Lapham, 1961).

The northern two-thirds of these quadrangles, underlain by Cambro-Ordovician limestones, shale, and dolomites, shows essentially no magnetic relief, except for a few small anomalies which are related to industrial plants in the city of Lebanon.

In the southern part of the area, Triassic sediments and intrusive diabase are in contact with the Cambro-Ordovician sediments. Here the magnetic map shows considerable magnetic variation due to the presence of the diabase and the magnetite ore bodies. The magnetic anomalies over the known ore bodies are not strikingly different from some of the anomalies over diabase which are known to be barren on the basis of exploration drilling. Thus there remains the question as to whether certain of the other untested anomalies can be attributed to diabase or to heretofore unknown ore bodies.

The anomalies of known source will be considered first. A quarter mile directly south of Burd Coleman Village, an anomaly occurs over the western half of the more westerly of the two, developed, iron-ore bodies at Cornwall (Figure 2, anomaly 3). This is an underground operation today, although it was originally developed as an open pit mine in 1742. The ore mineral is magnetite and the ore grade as mined is about 42 per cent iron content. Chalcopyrite yields some byproduct copper, gold, and silver, while the pyrite yields some byproduct cobalt. The ore was formed by replacement of the Cambrian limestone by hydrothermal solutions which were genetically related to Triassic diabase that cuts the limestone in the Cornwall area. Although this western ore body at Cornwall has been in production over 200 years, there are still quite a few million tons of ore remaining. It is of considerable interest that such a quantity of magnetite ore has resulted in a magnetic anomaly of less than 300 gammas amplitude and is limited to the western half of the ore body.

A half mile southeast of Cornwall Furnace there is a magnetic high (Figure 2, anomaly 5) with an amplitude of about 300 gammas which is developed over the more easterly of the two magnetite ore bodies being mined at Cornwall. This is an underground operation. Here too, the magnetite ore has replaced Paleozoic limestone which was overlain by Triassic sediments and underlain by Triassic diabase. As in the case of the more westerly ore body described above, this is a surprisingly small magnetic anomaly for an ore body with many millions of tons of magnetite remaining. A possible explanation may be in the fact that oriented ore specimens taken from the underground workings here have been found to have a remnant magnetization which plunges to the west at nearly 90 degrees from the present direction of the earth's magnetic lines of force. As a result, the earth's magnetic field partially counteracts the measured magnetic intensity of the ore body. It is difficult to assign an explanation for such a magnetic orientation in the ore but its practical significance is that, in this area, a geologic explanation should be sought for each anomaly, since a relatively insignificant anomaly might represent an ore body of significant dimensions.

A mile due south of Rexmont there is a magnetic high (Figure 2, anomaly 6) with an amplitude of about 150 gammas. On the surface this is an area of Triassic sediments, but nearby there is a small area of diabase exposed, suggesting that this anomaly is over an area where there is very likely a considerable mass of diabase just a short distance beneath the surface. Although it can be inferred that this magnetic high is attributable to diabase alone, a ferruginous mineral concentration within, adjacent to, or below the diabase is also possible. In this region of known magnetite mineralization no such anomaly should be overlooked in any comprehensive exploration program.

Due south of Cornwall Furnace, near Miners Village, there is a distinct magnetic high (Figure 2, anomaly 4) about a half mile in diameter with an amplitude of over 400 gammas. This magnetic feature exhibits the greatest amplitude and highest magnetic intensity of any in the Cornwall district; however, it lies only in part over the eastern edge of the western ore body. Nevertheless, it strongly indicates a significant mass of iron ore. The anomaly gradient and outline suggest a well defined, steeply dipping iron concentration at no very great depth. The proximity of this feature to the extensive westernmost Cornwall ore body is encouraging and offers the possibility of a new ore extension which genetically might have been the feeder pipe extending upward through the diabase to the known westernmost ore body.

About two miles east of Rexmont, and just east of the small Lebanon reservoir in the Richland quadrangle, there is a magnetic high (Figure 2, anomaly 7) about a half mile in diameter with an amplitude of over 250 gammas. This feature is directly underlain by Triassic shales, although the indications are that the diabase dike, which is exposed just to the north and east, dips under the sediments in the area of this anomaly. This is not a location of known iron mineralization. Examination of the surface rocks shows some contact metamorphic effects, such as darkening and induration of the normally red Triassic sediments. No ore mineralization is exposed. The magnetic anomaly which has a peak as high as the one over the westernmost operating Cornwall ore body may indicate a significant iron concentration either over, in, or below the diabase which dips below this location. One cannot establish the nature of the mineralization without core-drilling, but the structure of this particular location shows an unusual similarity to that which exists at the known Cornwall ore bodies just a couple of miles to the west. If, beneath the surface, there were a limestone mass in proximity to the diabase, it could have readily lent itself to ore replacement. Anomaly 7 (Figure 2) is one which strongly recommends itself to exploration for ore possibilities.

In the southwesterly portion of the Richland quadrangle, about a mile south-southeast of the small Lebanon reservoir, there is a magnetic high (Figure 2, anomaly 8) developed over the contact of Triassic diabase and sandstone.

This anomaly might be considered in conjunction with the magnetic high in the very southwest corner of the quadrangle (anomaly 9) as well as anomaly 10 which is in the southeast corner of the Lebanon quadrangle. These appear to be spatially related and probably have a common origin. The magnetic highs are not developed directly over the exposed diabase dike, but are located down the dip of the diabase. No mineralization has been noted at the surface. Since these anomalies have a lesser magnitude than those over the known ore bodies, and since they are nearly two miles south of the contact between the Triassic sandstones and the lower Paleozoic limestones, the likelihood of significant iron ore mineralization here appears to be quite limited. These magnetic highs may be the result of contact effects over the steeply dipping diabase, since metamorphism of the ferruginous Triassic sandstones has in many places been found to develop disseminated, fine-grained magnetite. These anomalies might also be the result of an iron-rich mineral concentration within the diabase. While the geologic and geophysical indications here (at anomalies 8 and 9) are not particularly encouraging with respect to economic iron concentrations, it would seem that any anomalous situation which is less than four miles from major iron ore concentrates merits further investigation.

A mile and a half south of Quentin in the Lebanon quadrangle there is a magnetic high (Figure 2, anomaly 11) centered over Triassic diabase. This intrusive mass is considered to be part of a basin-shaped sheet, but it is possible that the anomaly is developed over a feeder pipe of the diabase mass. The existence of a feeder pipe is suggested partly by the fact that nowhere else in the Cornwall area does the diabase exhibit an anomaly over its outcrop belt and partly by the location of this anomaly with respect to the general configuration of the diabase mass. As noted above, it is possible that this anomaly also could be the result of an iron rich concentration within the diabase. While the magnetic intensity is not as high as that which occurs over the known ore bodies, this is an area where perceptible anomalies merit consideration.

In the southwest corner of the Lebanon quadrangle, two magnetic highs occur in West Cornwall Township, about a mile northwest of Mount Gretna Heights. These peaks (anomalies 1 and 2) occur along a continuous magnetic high which trends in an east-west direction over a ridge of Triassic conglomerate, more or less parallel to the outcrop of diabase about a half mile to the north. The diabase dips under the Triassic sediments at this location and the general distribution and configuration of the outcrop pattern suggests that the diabase is at no considerable depth beneath this anomaly location. It is noteworthy that there is no magnetic anomaly over the adjacent area of exposed diabase, suggesting that the existing anomaly is either the result of a more significant diabase mass at depth, possibly a feeder to the diabase of the area, or else is due to a ferruginous concentration in the diabase at depth. Although this magnetic anomaly exhibits a maximum intensity somewhat lower than that which occurs over the known ore bodies, the proximity of high quality ore dictates further clarification of this anomaly.

From an overall examination of the magnetic pattern in the Cornwall area in the southern part of the Lebanon and Richland quadrangles, one is impressed by two features. First, there is the fact that there is a low magnetic intensity over the ore bodies known to have large tonnages of magnetite ore. Secondly, there is a rather impressive line of magnetic highs which includes anomalies 1, 2, 3, 4, 5, 6 and 7; actually, an examination of the Richland aeromagnetic map will show that three more very small magnetic highs fall along the line just to the east of figure 2 of this publication. This line of anomalies includes only two (anomalies 3 and 5, figure 2) which are over known ore bodies. Is it possible that this line of anomalies represents a feeder system controlled by a buried structure along which masses of ore and perhaps diabase were emplaced? This is a situation which would appear to merit careful exploration and reconsideration, all the more so because of the existence of known ore along part of the trend.

Manheim Quadrangle
U. S. Geological Survey Aeromagnetic Map G. P. 256

The southern 4/5 of the Manheim quadrangle aeromagnetic map has a simple pattern with practically no variation in magnetic intensity. It is an area of Ordovician shales and limestones which are overlapped by Triassic shales and sandstones to the north. Although the Paleozoic sediments have been involved in folding, the structure is nevertheless relatively simple.

In the northern portions of the quadrangle a curved belt of positive magnetic anomalies outlines the exposure of an irregular Triassic diabase sheet. The anomalies develop their maxima, about 250 gammas amplitude, along the contacts of the diabase where contact metamorphism of the slightly ferruginous Triassic sediments has resulted in some finely disseminated magnetite. Neither the magnetic data nor the geologic setting suggest any economically significant magnetic mineralization.

Lititz Quadrangle
U. S. Geological Survey Aeromagnetic Map G. P. 257

The Lititz quadrangle aeromagnetic map has an extremely simple, open magnetic pattern. Total magnetic variation in the quadrangle is 100 gammas and it would be less than that were it not for the existence of a diabase sheet in the northwestern corner of the quadrangle. Most of the quadrangle is underlain by lower Paleozoic limestone and shale. In the northern third of the area a wedge of northerly-dipping Triassic sandstones and shales overlaps the lower Paleozoic sediments. The magnetic map reflects the relatively simple structure of the area. No economically significant mineralization is indicated by the magnetic data.

Columbia East Quadrangle

U. S. Geological Survey Aeromagnetic Map G. P. 258

The Columbia East quadrangle aeromagnetic map has a very simple, open pattern except in the southwest corner of the area. There is complex structure in this quadrangle, involving extensive folding and faulting. However, in most of the quadrangle the lower Paleozoic limestones, dolomites, sandstones, and phyllite do not appear to have sufficient magnetic dissimilarities to record the structural variations.

In the southwest corner of the quadrangle, two elongate positive magnetic anomalies occur over the Susquehanna River. These anomalies each trend in a northeasterly direction, are less than a mile in length, and have amplitudes of about 300 gammas. There is no obvious explanation for their occurrence although it is possible they may be related to small amounts of matnetite in the Harpers-Antietam units of the area. Since these anomalies are relatively limited in area and amplitude, and are restricted to the Susquehanna River channel, they do not indicate a mineral concentration of economic significance.

Lancaster Quadrangle

U. S. Geological Survey Aeromagnetic Map G. P. 259

The Lancaster quadrangle aeromagnetic map exhibits very little magnetic variation. The one distinctive positive magnetic anomaly in the northwest part of the city of Lancaster, is an industrial plant. Other than that, the magnetic range is less than 100 gammas in the entire quadrangle.

This is an area underlain chiefly by limestones and dolomites, with lesser amounts of shale. Considerable faulting and folding are involved in the area, but the sediments have such similar magnetic properties that the structures are not indicated by the magnetic data, nor is there any magnetic indication of mineralization in the area.

Bibliography

Geyer, A. R., Gray, Carlyle, McLaughlin, D. B., Moseley, J. R. (1958), *Lebanon Quadrangle*, Pa. Geol. Survey, 4th ser., Bull. A 167c.

Gray, Carlyle, Geyer, A. R., McLaughlin, D. B. (1958), *Richland Quadrangle*, Pa. Geol. Survey, 4th ser., Bull. A 167d.

Gray, Carlyle and Lapham, D. M. (1961), *Guidebook to the geology of Cornwall*, Pa. Geol. Survey, 4th ser., Bull. G35.

Hickok, W. O. (1933), *The iron ore deposits at Cornwall, Pennsylvania*, Econ. Geology, v. 28, no. 3.

—————— (1939), *The minerals of Pennsylvania - Iron ores of Pennsylvania*, Pa. Geol. Survey, 4th ser., Bull. M 18b.

Jonas, A. I. and Stose, G. W. (1926), *New Holland Quadrangle*, Pa. Geol. Survey, 4th ser., Bull. A 178.

—————————————— (1930), *Lancaster Quadrangle*, Pa. Geol. Survey, 4th ser., Bull. A 168.

Knopf, E. B. and Jonas, A. I. (1929), *Geology of the McCalls Ferry-Quarryville District, Pennsylvania*, U. S. Geol. Survey Bull. 799.

Spencer, A. C. (1908), *Magnetite deposits of the Cornwall type*, U. S. Geol. Survey Bull. 359.